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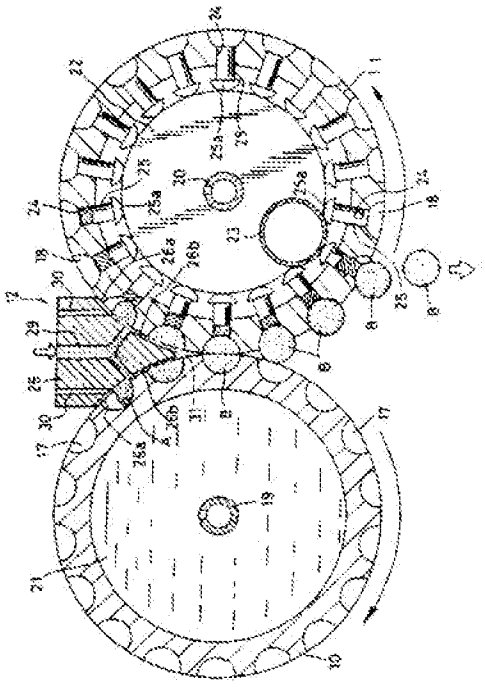
TITLE : APPARATUS FOR PRODUCING COLD FOOD BLOCK



ABSTRACT : PURPOSE: To provide an apparatus for the production of a cold food block and usable also for the production of ice candy, by using a pair of die rolls rotating at the same speed and having a pair of mutually correspooding hollows on the outer circumferences, making one of the die roll heatable and furnishing the other roll with a forced discharging means.

CONSTITUTION: A cooled food A is filled in hollow parts 17, 18 of rolls 10, 11 through a filling opening 29 of a filling apparatus 12 and the foods filled in the hollow parts 17, 18 are integrated with each other to form a spherical product B in the course of passing the hollow parts 17, 18 through a closing zone. The roll 10 is heated with a heating fluid 21 to prevent the adhesion of the food A to the wall of the hollow part 17. The product B is pushed out of the hollow part 18 and dropped by contacting a rod 25 with a cylinder 23 and protruding the rod 25 into the hollow part 18.

⑲日本国特許庁（JP）　⑪特許出願公開

⑫公開特許公報（A）　昭62－87056

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審査請求　未請求　発明の数 1　（全6頁）

⑤発明の名称　塊状冷食品の製造装置

⑳特　願　昭60－230710

㉒出　願　昭60(1985)10月15日

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明　細　書　(1)

1．発明の名称

塊状冷食品の製造装置

2．特許請求の範囲

外周面に互いに対応する1対の凹所(17)(18)の1またはそれ以上の多数が同じ速度で回転させられる1対のダイロール(10)(11)と，凹所(17)(18)に食品を充填する充填装置(12)とを備えており，一方のダイロール(10)の内部が加熱可能となされ，他方のダイロール(11)に，凹所(18)内にある成形後の製品を強制的に排出する手段が設けられている塊状冷食品の製造装置。

3．発明の詳細な説明

産業上の利用分野

この発明は、塊状冷食品の製造装置に関する。なお、この明細書において，冷食品という用語は、たとえばアイスキャンデー，アイスクリームなどの冷菓やバターなどのように冷却することにより固まって塊状にすることが可能な食品を全て含む意味に用いられる。

従来の技術とその問題点

たとえば球を扁平にした形の塊状チョコレートの製造装置として、水平に隙間なく並べて配置され，外周面に互いに対応する複数の凹所が形成され、かつその近接凹所（この明細書において、近接凹所とは、1対のダイロールが最も近接しまたは接触している凹所をいう。）において凹所同志が対向して下方に同じ速度で移動するように回転させられる1対のダイロールと，1対のダイロールの近接凹所より上方において各ダイロールの凹所にチョコレートを充填する充填装置とを備え，両方のダイロールの内部に

ダイロール冷却用の流体（ブライン）が供給されるものが知られている。チョコレートの場合、冷却されると収縮し、凹所の壁から剥離し易くなる。このため、各ダイロールの凹所に充填されたチョコレートは凹所が近接箇所を通過するときに一体に接合され、凹所が近接箇所より下方に移動して互いに離れるときに重力により凹所から簡単に離れて落下する。ところが、アイスキャンデーの場合には、冷却されると凹所の壁に付着し易くなるので、このような製造装置をそのまま適用することは不可能である。すなわち、アイスキャンデーの場合は、凹所が近接箇所を通過するときに一体に成形されたアイスキャンデーは両方のダイロールの凹所の壁に付着したままであるから、凹所が近接箇所より下方に移動して互いに離れるときに、一旦接合されたはずのアイスキャンデーが再び2つに別れて両方の凹所内に残ることがある。また、2つに別れなくても、いずれか一方のダイロールの凹所の壁に付着したまま1回転して、排出されないことがある。したがって、上記のような製造装置をそのまま利用してアイスキャンデーを確実に成形して排出することは困難である。

この発明の目的は、上記の問題を解決し、アイスキャンデーにも使用できる製造装置を提供することにある。

問題点を解決するための手段

この発明による棒状冷食品の製造装置は、外周面に互いに対応する1対の凹所の1またはそれ以上の多数が同じ速度で回転させられる1対のダイロールと、凹所に食品を充填する充填装置とを備えており、一方のダイロールの内部が加熱可能となされ、他方のダイロールに、凹所内にある成形後の製品を強制的に排出する手段が設けられているものである。

作　　用

1対のダイロールの凹所に充填された食品は、凹所が近接箇所を通過するときに一体に圧着、接合されて棒状に成形される。このとき、一方のダイロールがその内部より加熱されており、これにより食品の凹所の壁に接する部分が加熱されるので、成形された製品はこのダイロールの凹所の壁に付着することなく、必ず加熱されていない他方の凹所の壁に付着する。そして、この製品は排出手段により確実に凹所から排出される。

実　施　例

図面は棒形のアイスキャンデーの製造装置の1例を示し、この装置は、水平に隙間なく多数並べて配置された1対のダイロール(10)(11)と、これらの近接箇所の上方に配置された充填装置(12)とを備えている。

2個のロール(10)(11)は中空状をなし、その外周面に互いに対応する複数の半球状の凹所(17)(18)が円周方向に同じ間隔をおいて形成されている。なお、各ロール(10)(11)の凹所(17)(18)の直径は互いに等しい。第1のロール(10)は、図示しない適宜な駆動装置に連結された回転軸(19)に固定されている。第2のロール(11)は、回転軸(19)と平行な固定軸(20)に回転自在に支持され、たとえば歯車などの適宜な手段により回転軸(19)に連結されている。そして、2個のロール(10)(11)は、近接箇所において凹所(17)(18)同志の位置が一致したうえ、下方に同じ速

度で移動するように、図面の矢印方向に一定速度で回転させられる。

第１のロール(10)の両端は適宜な手段により密閉されており、ロール(10)の内部にはアイスキャンデーがややとけ出す程度の温水よりなるロール加熱用流体(21)が連続的に供給される。なお、ロール加熱用流体(21)としては、温水以外にもたとえば加熱された油などの液体や加熱された空気などの気体も使用できる。

第２のロール(11)の内部の固定軸(20)に、複数の円環(22)が固定され、これらの円環(22)の外周部に、固定軸(20)と平行な１本の円筒(23)が固定されている。この円筒(23)は固定軸(20)より少し第１のロール(10)寄りの下方に位置しており、円筒(23)の一部は円環(22)の外周面より少し突出している。そして、これらの円環(22)と円筒(23)により、一種のカムが構成されている。もっとも、この円環(22)と円筒(23)を一体としたすなわち円筒(23)の位置において円筒状突起を有する円環(22)とし、円筒(23)を省略してもよい。第２のロール(11)の各凹所(18)の底部には、ロール(11)の周壁を放射方向に貫通する複数のガイド穴(24)があけられ、各穴(24)にはロッド(25)が軸方向摺動自在にはめられている。各ロッド(25)の内端には他の部分より直径の大きい頭部(25a)が一体に形成され、頭部(25a)の端面は球面に形成されている。また、各ロッド(25)の外端部は、凹所(18)の底部形状と一致するような凹状の球面に形成されている。第２のロール(11)の両端は適宜な手段により密閉されており、ロール(11)の内部の密閉空間が図示しない真空ポンプに接続されている。そして、ロール(11)の内部を減圧することにより、各ロッド(25)が常に内側に吸引されており、これらの頭部(25a)が円環(22)または円筒(23)の外周面に接している。そして、ロッド(25)は、円環(22)に接しているときには、凹所(18)よりロール(11)の内側に退入してその外端部が凹所(18)の底部と一致し、円筒(23)に接しているときには、凹所(18)の底部から凹所(18)内に突出するようになっている。

充填装置(12)は、複数の充填用プレート(26)と吸引用プレート(27)よりなる。充填用プレート(26)はロール(10)(11)の上方に、吸引用プレート(27)はロール(10)(11)の両側にくるようにロール(10)(11)の軸方向に交互に複ねられ、適宜な手段により一体状に固定されている。充填用プレート(26)の下部両側部には２個のロール(10)(11)に常時接触可能な形状をもつ嵌合凸面(26a)と、その内側の凹みであるみぞ(26b)とが設けられている。吸引用プレート(27)の下部両側面はロール(10)(11)と嵌合凸面(26a)との接触面をおおってしまうよう充填用プレート(26)より幅広にしてある。充填用プレート(26)の下端は２個のロール(10)(11)の近接個所の少し上方まで達している。このみぞ(26b)の幅は、凹所(17)(18)の直径とほぼ等しいかやや大きくしてある。充填用プレート(26)には、その上面中央から下方にのびたのち二股に分岐してみぞ(26b)の中間部に開口した充填穴(29)が形成されている。また、充填用プレート(26)の両側寄りの部分には、その上面からみぞ(26b)の上寄りの部分に達する吸引穴(30)が形成されている。吸引用プレート(27)の下端は充填用プレート(2

6)の下端より下方に長くして、ロール(10)(11)の近接箇所と同じ位置またはそれより少し下方にまで達している。吸引用プレート(27)には、その上面中央から下方にのびたのち充填用プレート(26)の下端より少し下方で近接箇所より上方にロール(10)(11)の軸方向にのびて両面に開口した吸引穴(31)が形成されている。なお、図示は省略したが、ロール(10)(11)と吸引用プレート(27)の多数を交互に重ね合わせた全体において、その両端の吸引用プレート(27)においては、吸引穴(31)の下端は充填用プレート(26)側の片面にのみ開口している。また、充填穴(29)の上端はアイスキャンデー供給装置に接続され、吸引穴(30)(31)の上端はアイスキャンデー吸引ポンプに接続されている。

上記の製造装置において、アイスキャンデー供給装置から充填装置(12)の各充填穴(29)にたとえば－7～－6℃のアイスキャンデー（Ａ）が連続的に供給される。このアイスキャンデー（Ａ）は充填穴(29)の下端開口からこの部分に移動してきた各ロール(10)(11)の凹所(17)(18)内に充填される。このとき、凹所(17)(18)内にあった空気は充填用プレート(26)のみぞ(26b)の部分を通って上方に排出され、凹所(17)(18)内に空気が残ることがない。また、第２のロール(11)のロッド(25)は凹所(18)の底部よりロール(11)の内側に進入して円環(22)に接しているので、アイスキャンデー（Ａ）は凹所(18)全体に半球状に充填される。また、アイスキャンデー（Ａ）は、凹所(17)(18)にのみ充填されるのではなく、みぞ(26b)の部分にも充填されることとなる。このようにして対応する凹所(17)(18)に充填されたアイスキャンデー（Ａ）は、凹所(17)(18)が近接箇所を通過する間に一体に成形されて球状のアイスキャンデー製品（Ｂ）になる。このとき、アイスキャンデー（Ａ）は凹所(17)(18)の外側に盛上っているので、互いに強い力で接触して完全に一体に接合される。なお、アイスキャンデー（Ａ）が一体化されるときに、余ったアイスキャンデー（Ａ）は吸引用プレート(27)の吸引穴(31)から吸引されて排出される。このため、製品（Ｂ）の接合部に過剰のアイスキャンデー（Ａ）によるひれ状の突起などができるおそれがない。また、余ったアイスキャンデー（Ａ）が充填用プレート(26)のみぞ(26b)の上部に移動してきても、充填用プレート(26)の吸引穴(30)から吸引されて排出されるため、みぞ(26b)が詰って空気抜きができなくなるようなことがない。第１のロール(10)はアイスキャンデー（Ａ）により冷却されるが、加熱用液体(21)により加熱されており、これによりアイスキャンデー（Ａ）の凹所(17)の壁に接する部分が加熱されるので、アイスキャンデー（Ａ）は凹所(17)の壁に付着しにくくなっている。したがって、製品（Ｂ）は必ず第２のロール(11)の凹所(18)の壁に付着する。なお、ロール加熱用流体(21)の種類、流量および温度などは、製品（Ｂ）が凹所(17)の壁から容易に離れ、しかもロール(10)があまり高温にならないように適当に決められる。球形に成形された製品（Ｂ）は第２のロール(11)の凹所(18)の壁に付着して、ロール(11)の回転につれて下方に移動する。そして、ロッド(25)が円環(23)に当って凹所(18)内に突出することにより、これに沿さ

れて製品（B）が凹所(18)から排出され、重力により落下する。なお、第2のロール(11)もアイスキャンデー（A）によって冷却されるが、あまり低温になると製品（B）が離れにくくなるため、図示は省略したが、適当な部分にヒータを設けてこれを適温に保っている。

ダイロール(10)(11)および充填装置(12)の各部の構成、製品の排出手段などは、上記実施例のものに限らず、適宜変更可能である。たとえば、充填装置(12)は、全体が一体に構成されてもよい。ロッド(25)は、たとえば空気シリンダなどのように流体圧を利用して進退させられてもよい。また、空気などの圧力により直接製品を凹所(18)から排出することも可能である。

この発明による製品装置は、アイスキャンデー以外の棒状冷食品にももちろん適用できる。

(10)(11)…ダイロール、(12)…充填装置、(17)(18)…凹所、(21)…ロール加熱用流体、（A）…アイスキャンデー、（B）…アイスキャンデー製品。

以上

特許出願人　江崎グリコ株式会社

代　理　人　岸本　瑛之助（外4名）

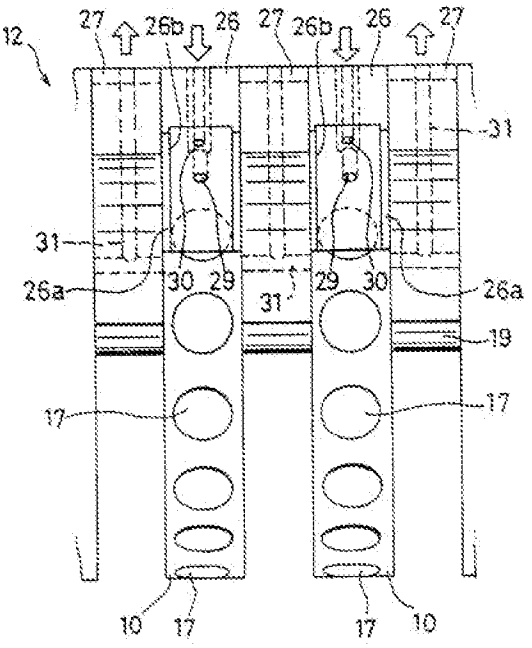
また、製品の形状も棒形に限られない。

発明の効果

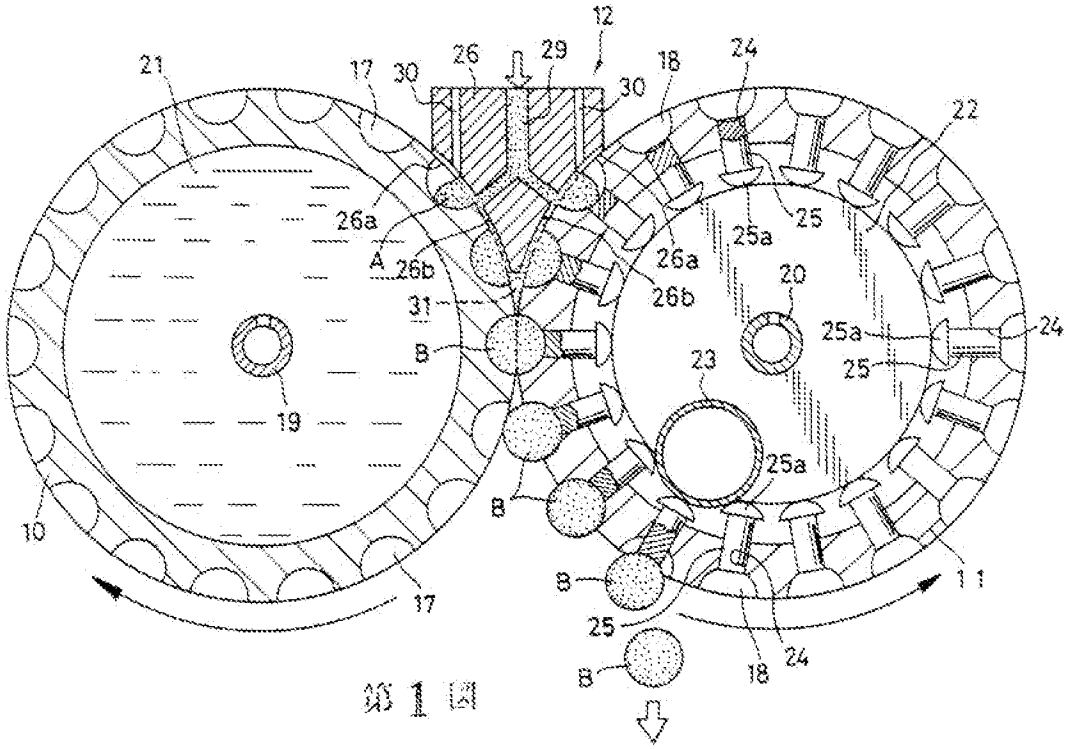
この発明の棒状冷食品の製造装置は、上述の構成を有するので、アイスキャンデーやそれ以外のものにも適用でき、1対のダイロールの凹所に充填されたアイスキャンデーなどを確実に棒状に成形してこれを確実に排出することができる。

4．図面の簡単な説明

図面はこの発明の実施例を示し、第1図は1対のダイロールを充填装置の充填用プレートの部分で切断した横断面図、第2図は1対のダイロールを充填装置の吸引用プレートの部分で切断した横断面図、第3図は第2のダイロールを取除いて残りを第1図の右から見た断面図である。



第3図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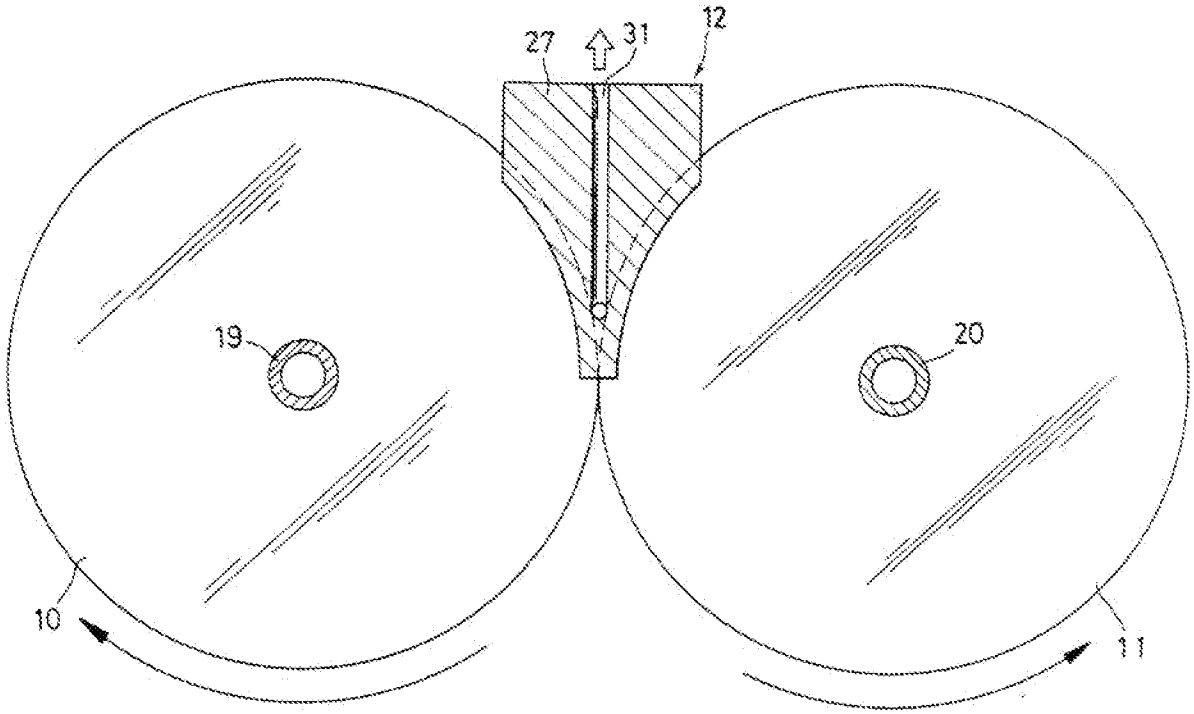
第1図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第2図

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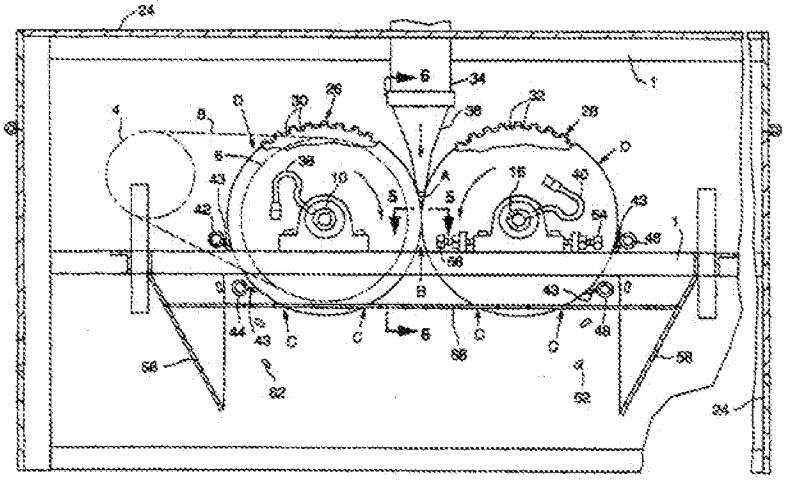

(57) Abstract

Input food is extruded between a pair of counter-rotating wheels (26, 28) whose outer surfaces define mold cavities (30, 32). The deposited input food is molded into pieces having desired shape by compression between aligned, counter-rotating mold cavity pairs (30, 32). Preferably, the input food is heated prior to molding to prevent irreversible set up, and the wheels (26, 28) are chilled to cause deposited food to set up as it is compressed and carried between aligned, chilled mold cavities (30, 32) from a loading station to a release station. After the input food is molded and set up into pieces, the rotating cavities separate at a release station, allowing the molded pieces to fall away from the wheels (26, 28). To ensure ejection of all molded pieces from the cavities (30, 32) before refilling, it may be desirable to mist the empty cavities with a non-toxic release agent such as glycerine.

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METHOD AND APPARATUS FOR PRODUCING MOLDED FOOD PIECES

Field of the Invention

The invention relates to a method and apparatus for molding food, such as prune paste or other fruit paste, into usefully shaped pieces having controlled texture and hardness, and to molded food products produced by such method and apparatus.

Background of the Invention

A conventional food processing system includes a rotating wheel which contains chilled coolant fluid. Food products (such as extruded ribbons or sheets of food paste) are conveyed onto the outer surface of the wheel, and are quickly frozen or chilled as the rotating wheel carries them along a circular path portion to an unloading station.

However, until the present invention, it was not known how to efficiently mold sticky food (particularly, fruit paste) into pieces of desired size and shape, with controlled texture and hardness and achieve effective demolding of the product.

Summary of the Invention

In accordance with the invention, paste-like input food, which can be fruit paste such as prune paste, is extruded between a pair of counter-rotating wheels. The outer surfaces of the wheels define mold cavities, and the extruded input food is molded into pieces having desired shape as it is pressed between aligned, counter-rotating pairs of the mold cavities. Preferably, the input food is heated prior to molding to prevent it from irreversibly setting up until after it is compressed between the mold cavities. The wheels can be chilled (such as by chilled coolant fluid flowing through channels within them), to cause the molded portions to set up (irreversibly) as they

are conveyed between aligned, chilled mold cavities along a generally linear path from a loading station to a release station. In preferred embodiments, the wheels are chilled sufficiently to maintain the mold cavities at a temperature in the range from about -10°F to about 32°F. The mold cavity temperature is 0°F in one preferred embodiment. Alternatively, the wheels can be heated in order to set up (i.e., by heat setting or baking) food portions compressed between aligned mold cavities as such portions are conveyed by the wheels.

The input food is preferably deposited between the counter-rotating wheels at a loading station located just above the location at which the wheel surfaces touch (or very nearly touch) each other, in the form of an extruded sheet. Portions of the input food sheet are compressed between counter-rotating mold cavity pairs as the wheels carry them past the loading station.

After the input food is deposited and compressed, the rotating cavities separate at a release location (release station), allowing the molded pieces to fall away from the wheels. Because some molded pieces may remain stuck to one of the wheels, positive product ejection means (which can be a set of one or more air knives) should be provided downstream from the release station (along the circular path traversed by each mold cavity) for purging each mold cavity of its contents prior to refilling with new, unmolded deposits of input food.

To ensure that all molded pieces will be ejected from the mold cavities before the cavities are refilled, it is sometimes desirable to mist the empty cavities during each revolution of each wheel, with a non-toxic lubricant such as glycerine, to reduce adhesion between the molded pieces and the mold

cavities. For example, nozzles which emit glycerine mist can be positioned for lubricating the mold cavities before they are filled and refilled. Alternatively (or additionally), mold release additives can be mixed with the input food before it is deposited between the wheels to reduce adhesion between molded pieces and the mold cavities after molding.

In a class of preferred embodiments, the input food is a fruit paste mixed with additives, comprising (by weight) 60% prune paste (having about 25% water content) and 15-16% glycerine. The function of the glycerine is to control water activity to give the molded pieces a soft and pliant texture. Optionally, sorbitol is included in the mixture in an amount experimentally determined to produce a desired water activity and humectancy of the molded product. To adjust the sugar to acid ratio, the mixture should include (by weight) 13% fructose, 3% sucrose, 0.12% citric acid (and tartaric acid, plum essence, and appropriate flavoring in small amounts experimentally determined to produce a desired molded product flavor). To reduce bulk density and give the molded product a less gummy mouth feel, the mixture should include 1.25% citrus fiber and 2.45% oat fiber. The mixture also preferably includes a mold releasing agent (which can be Alpha-dim 90 or BFP-65K) in an amount of about 1% by weight to reduce adhesion between the molded pieces and the mold cavities, and a solidifying agent such as Manugel-C in an amount of about 0.4% by weight.

Molded pieces produced in accordance with the inventive method (such as pieces having the composition described in the previous paragraph) are within the scope of the invention.

The inventive mold cavities employed are desirably shaped so that the molded pieces of prune paste have shapes simulating pitted prunes or berries.

In preferred embodiments, unmolded prune paste is maintained in a heated hopper at a temperature in the range from about 180°F to 212°F prior to molding. The hopper is heated with low grade heat and has high residual capacity (it can be identical or similar to a double boiler) to prevent exposure of the paste to excessively high heat from the surface of the hopper.

Brief Description of the Drawings

Figure 1 is a perspective view of a preferred embodiment of the apparatus of the invention.

Figure 2 is a perspective view of a molded food piece produced by the Figure 1 apparatus.

Figure 3 is a cross-sectional view of the Figure 1 apparatus, taken along line 3-3 of Figure 1.

Figure 4 is a cross-sectional view of the Figure 1 apparatus, in a vertical plane.

Figure 5 is a cross-sectional view of a portion of the Figure 4 apparatus, taken along line 5-5 of Figure 4.

Figure 6 is an elevational view of a portion of the Figure 4 apparatus, from the plane defined by line 6-6 of Figure 4.

Figure 7 is a side cross-sectional view of the air knife portion of the Figure 4 apparatus.

Figure 8 is a schematic diagram of the fluid flow components of the Figure 1 apparatus, including a fluid cooling tank not shown in Fig. 1.

Figure 9 is a top elevational view of a pair of counter-rotating wheels employed in a second preferred embodiment of the invention.

Figure 10 is a top elevational view of a pair of counter-rotating wheels employed in a second preferred embodiment of the invention.

Figure 11 is a perspective view of a berry-shaped molded food piece produced by the apparatus of Fig. 9 or Fig. 10.

Figure 12 is a perspective view of a detail of a variation of the apparatus of Fig. 4.

Detailed Description of the Preferred Embodiment

A first preferred embodiment of the apparatus of the invention will be described with reference to Figures 1 through 8. Although this embodiment can be employed to mold prune paste (with additives as described below) into food pieces which resemble pitted prunes, such as piece 62 shown in Fig. 2, it can also be employed to mold other food products.

As shown in Figures 1, 3, and 4, the apparatus includes counter-rotating wheels 26 and 28. Wheel 26 is fixedly attached around shaft 10 and wheel 28 is fixedly attached around shaft 16. Shaft 10 extends through bearings 10a attached to frame 1, so that shaft 10 is free to rotate within bearings 10a relative to frame 1, and shaft 16 extends through bearings 16a attached to frame 1, so that shaft 16 is free to rotate within bearings 16a relative to frame 1.

The outer surface of wheel 26 defines a set of mold cavities 30, and the outer surface of wheel 28 defines a set of corresponding mold cavities 32. Input food 61 (shown in Figs. 5 and 6) preferably has a homogeneous, soft, paste-like consistency, and is extruded out from extruder nozzle 36 into the region between wheels 26 and 28 (at a loading station "A" shown in Figs. 4 and 6). Wheels 26 and 28 are driven so that each cavity 30 is always aligned with a

corresponding cavity 32 at the intersection of wheels 26 and 28. Rotating wheel 28 is biased against counter-rotating wheel 26, so that the apparatus molds input food 61 into specially shaped individual pieces (such as piece 62 shown in Fig. 2) as food 61 is compressed within the volume enclosed by each aligned pair of cavities 30 and 32 (as shown in Fig. 5).

As shown in Figs. 3 and 6, mold cavities 30 and 32 are arranged in very closely packed fashion on the outer surface of wheels 26 and 28. There are three staggered rows of mold cavities around each wheel, with an alternating pattern of two cavities (e.g., cavities 32A of Fig. 6) and one cavity (e.g., cavity 32B of Fig. 6) across the width of the wheel.

Rotatable shaft 10 is mounted to frame 1 with its rotational axis (aligned vertically in Fig. 3) fixed relative to frame 1, and rotatable shaft 16 is mounted to frame 1 with its rotational axis (aligned vertically in Fig. 3) having a limited range of motion relative to frame 1. Two pairs of adjustment screws 64 and 66 mounted to frame 1 are provided for adjusting the position of shaft 16 (and bearings 16a through which it extends) relative to frame 1, so as to bias wheel 28 against wheel 26. By retracting screws 66 (to the left in Fig. 3) while advancing screws 64 (to the left in Fig. 3), shaft 16 can be displaced toward shaft 10 until rotating wheel 28 is biased against counter-rotating wheel 26 with sufficient force to mold input food 61 into individual pieces 62 as the food is compressed between aligned mold cavities and is carried by the aligned mold cavities from a loading station (e.g., location "A" in Figs. 4 and 6) to a "release" station (e.g., location "B" in Figs. 4 and 6). In alternative preferred embodiments, adjustable screw

assemblies 64 and 66 are replaced by a means for spring-loading shaft 16 toward shaft 10 with wheel 28 in direct contact with wheel 26, and with wheel 28 exerting sufficient biasing force to mold input food 61 into individual pieces 62 as the food is compressed between aligned mold cavities and is carried thereby from the loading station (e.g., location "A" in Fig. 4) to the "release" station (e.g., location "B" in Fig. 4).

Typically, the diameter of each of wheels 26 and 28 is about ten inches, and the outer surfaces of wheels 26 and 28 (defining mold cavities 30 and 32) are made of stainless steel (preferably, of the type known as "304" stainless steel). Each wheel 26 and 28 is manufactured with mold cavities (30 or 32) of desired shape formed (such as by a machining or casting operation) in its outer cylindrical surface.

Gear 12 is fixedly attached to shaft 10, and gear 14 is fixedly attached to shaft 16 so that the teeth of gear 14 intermesh with the teeth of gear 12. Wheel 6 is fixedly attached to shaft 10. Wheel 4 is rotated by motor 2. Drive belt 8 is looped around wheels 4 and 6, so that rotating wheel 4 causes belt 8 to rotate wheel 6, shaft 10, gear 12, and wheel 26 as a unit. As gear 12 rotates clockwise (causing wheel 26 to rotate clockwise, as shown in Fig. 4), gear 12 forces gear 14, shaft 16, and wheel 28 to rotate as a unit in a counterclockwise direction (as indicated in Fig. 4).

Motor 2 is preferably of a type which can be controlled to drive counter-rotating wheels 26 and 28 at precisely selectable, variable rotational speeds.

Many of molded pieces 62 drop directly onto conveyor belt 60 (shown in Fig. 6 but not Figs. 3 and 4) when counter-rotating wheels 26 and 28 carry them to release station B (shown in Fig. 4) below loading

station A. However, some pieces may cling to cavity 30 or cavity 32 even after reaching location B, although the mold cavities in which such pieces were formed will have separated from each another by that point. Any such pieces 62 that cling to one of cavities 30 and 32 as counter-rotating wheels 26 and 28 continue to carry them, will be ejected by high pressure gas streams 43 emitted from air knives 42, 44, 46, and 48. Conveyor belt 60 receives pieces 62 that are ejected from wheels 26 and 28 by air knives 42, 44, 46, and 48 (and those that fall downward at release location B). Each of the air knives is fixedly mounted to frame 1.

Front and back panels 58 are mounted on frame 1 in positions to catch pieces 62 that have been blown off wheels 26 and 28 by gas streams 43, and to direct these pieces downward toward conveyor 60.

To ensure that all molded pieces 62 will be ejected from the mold cavities before the cavities are refilled, it may be desirable to mist the empty cavities during each revolution of each wheel with a non-toxic lubricant such as glycerine, to reduce adhesion between the molded pieces 62 and the mold cavities. For example, nozzles which emit glycerine mist can be positioned at locations "D" shown in Fig. 4 to lubricate the mold cavities before they are filled and refilled. Alternatively (or additionally), "mold release" additives (to be discussed below) can be mixed with input food 61 before it is deposited between wheels 26 and 28 to reduce adhesion between molded pieces 62 and mold cavities 30 and 32.

Two wires 68 (shown in Figs. 4 and 6) can be stretched between panels 58 on opposite sides of wheels 26 and 28. Each of wires 68 cuts off excess food from edges of counter-rotating wheels 26 and 28

at its points of intersection with the outer edges of the wheels (e.g., at locations C shown in Fig. 4).

In addition to wires 68 (or as a substitute therefor), cheek plates (such as cheek plates 91 and 93 shown in Fig. 12) are preferably mounted between wheels 26 and 28 around the loading station to prevent input food 61 from escaping from the loading station except by being compressed between a pair of aligned mold cavities. As shown in Fig. 12, cheek plate 91 and cheek plate 93 are fixedly mounted to rigid portions 1A of frame 1 in positions so that the outer surfaces of wheels 26 and 28 ride directly on plates 91 and 93 (and so that plates 91 and 93 and wheels 26 and 28 surround loading station A). As wheels 26 and 28 counter-rotate in the directions shown in Fig. 12, the edges of the wheels' outer surfaces slide relative to plates 91 and 93. To minimize the friction between plates 91 and 93 and wheels 26 and 28, plates 91 and 93 are preferably made of Teflon material, or some other highly lubricated or low-friction material.

In a variation on the Fig. 12 apparatus, a pair of small, counter-rotating wheels can be employed in place of cheek plates 91 and 93. Such small wheels should be oriented with parallel rotational axes, with these rotational axes oriented perpendicular to shafts 10 and 16. The small wheels should roll directly against the sides of wheels 26 ad 28, to prevent excess food 61 from escaping from the loading station except by being compressed between a pair of aligned mold cavities of wheels 26 and 28.

Heated hopper 34 is preferably double walled, and heated water is pumped through the space between its walls to maintain input food 61 (within the inner wall) at a selected temperature in the range from about 120°F to 212°F (and preferably from about 180°F

to 212°F), without exposing food 61 (and especially the portion of food 61 in direct contact with the inner wall of hopper 34) to excessively high heat. Hot water intake line 35 (shown in Fig. 1) supplies heated water to the space between hopper 34's walls, and outlet line 33 (shown in Fig. 1) removes water from such space following heat transfer from the water to food 61.

The purpose of heating food 61 (in preferred embodiments) before depositing it between wheels 26 and 28 is to prevent it from irreversibly solidifying ("setting up") so that it can be mixed and extruded. As will be explained below, this is particularly important in cases where food 61 is prune paste, apricot paste, or another fruit paste. In preferred embodiments, wheels 26 and 28 are cooled to cause each food piece being compressed between cavities 30 and 32 to set up rapidly. In alternative embodiments it may be unnecessary to heat food 61 prior to molding, and it may be desirable to heat rather than cool wheels 26 and 28. An example of the latter embodiment is one in which input food 61 is a batter that is rapidly baked (or partially baked) as it is molded into pieces 62 between heated cavities 30 and 32.

Any of a variety of mechanisms for extruding or otherwise depositing input food product 61 between wheels 26 and 28 can be employed in alternative embodiments of the invention. Preferably, input food 61 is deposited in the form of a sheet which is compressed between the counter-rotating wheels at a point where the wheels' outer surfaces touch (or very nearly touch) each other. Alternatively, the inventive apparatus can include a depositing means which cleanly and accurately meters and deposits precise volumes of input food 61 into the rotating

mold cavities at precisely correct times to prevent smearing or over-filling. For example, extruder nozzle 36 of Figs. 4 and 6 could be preferably sized, shaped, and driven in pulsed fashion to deliver a sheet of food 61 having periodically varying width between wheels 26 and 28, with the sheet having greater width at times when simultaneously received by two pairs of mold cavities 30 and 32 (e.g., cavities 32A of Fig. 6 and corresponding cavities 30), and narrower width at times when received by a single pair of mold cavities 30 and 32 (e.g., cavity 32A of Fig. 6 and the corresponding cavity 30). Some such alternative embodiments of the depositing means may desirably be capable of consistently depositing correct amounts of input food to prevent fouling of the molds and wheels, and to eliminate production of feather-edged pieces.

Fluid channel 26A (shown in Fig. 8) extends through wheel 26 and fluid channel 28A (shown in Fig. 8) extends through wheel 28, so that heated or chilled fluid can be pumped through the wheels to heat or cool cavities 30 and 32. In the preferred embodiment of Figures 1-8, chilled coolant fluid (preferably, a commercially available orange peel oil product known as "D-Limonene" fluid) is pumped through channels 26A and 28A to maintain mold cavities 30 and 32 at a temperature in the range from about -10°F to about 32°F, in order to set up each molded piece 62 irreversibly as the piece is carried by wheels 26 and 28 along a generally linear path from the loading station to the release station at which it falls off both wheels (or at which it falls off one of the wheels, and is then carried by a second one of the wheels along a portion of a circular path until it is blown off the second wheel by one of air knives 42, 44, 46, and 48).

To prevent ambient water vapor from freezing on the chilled mold cavities 30 and 32, wheels 26 and 28 are maintained in a dry carbon dioxide environment during operation of the inventive apparatus. To achieve this purpose, enclosure 24 (which can be made of transparent plastic) surrounding wheels 26 and 28 is supplied with dry carbon dioxide gas at pressure greater than atmospheric pressure (for example, from air knives 42, 44, 46, and 48), to displace ambient air and thus prevent ambient air (with water vapor) from reaching mold cavities 30 and 32. Enclosure 24 can have an open bottom (as shown in Fig. 6) to allow the finished pieces 62 to fall onto conveyor 60 (shown in Fig. 6) and allow excess carbon dioxide gas to escape. Enclosure 24 preferably has hinged doors 24a (such as those shown in Figs. 4 and 6) which can be opened to permit access to the mechanical components within enclosure 24.

As best shown in Fig. 8, chilled coolant fluid 72 is pumped from tank 70 through line 74, and then through lines 76 and 78 to valves 18 and 20, respectively. If valve 18 is open, fluid 72 flows through valve 18 into line 37, through line 37 into channel 26A within wheel 26, and then out from channel 26A to line 38. If valve 20 is open, fluid 72 flows through valve 20 into line 39, through line 39 into channel 28A within wheel 28, and then out from channel 28A to line 40. Line 37 extends through shaft 10 (as shown by the dashed line in Fig. 3) until just before it connects with channel 26A, and line 38 extends through shaft 10 (except for its inlet end portion, shown in Fig. 3, connected to the outlet of channel 26A). Similarly, line 39 extends through shaft 16 (as shown by the dashed line in Fig. 3) until just before it connects with channel 28A, and line 40 extends through shaft 16 (except for its

inlet end portion, shown in Fig. 3, connected to the outlet of channel 28A). Fluid 72 flows from the outlet ends of lines 38 and 40 into connector 22, from connector 22 into line 23, and through line 23 back to tank 70.

As shown in Fig. 3, rotary union 71 couples non-rotating valve 18 and fluid line 76 to rotating shaft 10, and another rotary union 71 couples non-rotating valve 20 and fluid line 78 to rotating shaft 16. Coolant fluid can flow from line 76 through valve 18 and union 71 into line 37 within shaft 10, and coolant fluid can flow from line 78 through valve 20 and union 71 into line 39 within shaft 16. Similarly, rotary union 73 couples non-rotating connector 22 to an end of rotating shaft 10, and another rotary union 73 couples non-rotating connector 22 to an end of rotating shaft 16.

Liquid carbon dioxide is supplied to tank 70 from inlet line 74. The carbon dioxide chills fluid 72 within tank 70 as follows: the liquid carbon dioxide transforms into gaseous carbon dioxide on contact with fluid 72, and the carbon dioxide gas bubbles up through the fluid 72 (as indicated in Fig. 8). The carbon dioxide gas then escapes from the top of tank 70 through line 49.

Pressurized carbon dioxide gas is supplied through gas line 50 to air knives 42 and 44 within enclosure 24, and from line 50 through gas line 52 to air knives 46 and 48 within enclosure 24.

Each of air knives 42, 44, 46, and 48 includes a slit (or set of holes) which directs a stream 43 of pressurized carbon dioxide gas onto the adjacent wheel. Examples of such slits are slit 46A through the sidewall of generally cylindrical air knife 46, and slit 48A through the sidewall of generally cylindrical air knife 48, as shown in Fig. 7.

A second preferred embodiment of the apparatus of the invention will be described with reference to Fig. 9. This second embodiment is identical to the above-described first embodiment, except that its mold cavities 130 and 132 are differently shaped than mold cavities 30 and 32 of the first embodiment. The second embodiment molds the input food paste (preferably prune paste with additives as described below) to produce berry-shaped food pieces, such as piece 162 shown in Fig. 11. As shown in Fig. 9, cavities 130 and 131 are slightly elongated, and oriented with their long axes perpendicular to parallel shafts 110 and 116, around which wheels 126 and 128 respectively rotate. In the Fig. 9 embodiment, there are four staggered rows of mold cavities around each wheel, with an alternating pattern of three cavities and two cavities across the width of the wheel.

A third preferred embodiment of the apparatus of the invention will be described with reference to Fig. 10. This third embodiment is identical to the above-described second embodiment, except that its counter-rotating wheels 226 and 228 are wider than corresponding wheels 126 and 128, and in that there are more mold cavities 230 and 232 arranged across the width of each of wheels 226 and 228. The third embodiment molds an input food paste (preferably prune paste with additives as described below) to produce berry-shaped food pieces identical to those of the Fig. 10 embodiment. In the Fig. 10 embodiment, there are seven staggered rows of mold cavities around each wheel, with an alternating pattern of four cavities and three cavities across the width of the wheel.

It is contemplated that in various embodiments of the invention, the counter-rotating wheels can

have any of a variety of widths. For example, the wheels can have a width of 1.5 inches or less in some embodiments, and in other embodiments the wheels can have width in the range from about seven inches to about twenty inches or more.

In preferred embodiments, the inventive method includes the steps of heating a fruit paste (such as prune paste) to prevent the paste from irreversibly setting up before molding, extruding the heated paste into a sheet, and molding the sheet into portions having desired shape by pressing the paste between counter-rotating wheels. Typically, the wheels are chilled (such as by chilled coolant fluid flowing through channels within the wheels), and the molded portions are set up (irreversibly) as they are conveyed between aligned mold cavities of the chilled wheels from a loading station to a release station. Typically, the wheels are chilled sufficiently to maintain the mold cavities at a temperature in the range from about -10°F to about 32°F (the mold cavity temperature is 0°F in one preferred embodiment). Alternatively, the wheels can be heated in order to set up (i.e., by baking) the food portions compressed between aligned mold cavities thereof as such portions are conveyed by the wheels from a loading station to a release station.

In preferred embodiments, unmolded prune paste is maintained in a heated hopper at a temperature in the range from about 180°F to 212°F prior to molding. The hopper is heated with low grade heat and has high residual capacity (it can be identical or similar to a double boiler) to prevent exposure of the paste to excessively high heat from the surface of the hopper.

The input food paste is preferably deposited at a loading station in the form of a sheet, in a manner so that the sheet is compressed between counter-

rotating wheels (with portions of the paste between aligned mold cavity pairs).

After the input paste is deposited and compressed, the rotating cavities separate at a "release" location (or station), allowing the molded pieces to fall away from the wheels. Because some pieces may remain stuck to one of the wheels, positive product ejection means (which can be a set of one or more air knives) should be provided downstream from the release station for purging each mold cavity of its contents prior to refilling with new, unmolded deposits of paste.

To ensure that all molded pieces will be ejected from the mold cavities before the cavities are refilled, it may be desirable to mist the empty cavities during each revolution of each wheel, with a non-toxic lubricant such as glycerine, to reduce adhesion between the molded pieces and the mold cavities. For example, nozzles which emit glycerine mist can be positioned for lubricating the mold cavities before they are filled and refilled. Alternatively (or additionally), "mold release" additives can be mixed with the input food paste before it is deposited between the wheels to reduce adhesion between molded pieces and the mold cavities after molding.

In a class of preferred embodiments, the input food is a fruit paste mixed with additives, comprising (by weight) 60% prune paste (the prune paste should have about 25% water content) and 15-16% glycerine. The function of the glycerine is to control water activity to give the molded pieces a soft and pliant texture. Optionally, sorbitol is included in the mixture in an amount experimentally determined to give the molded product a desired water activity and humectancy. To enhance flavor

expression, the mixture should include (by weight) 13% fructose, 3% sucrose, 0.12% citric acid (and tartaric acid, plum essence, and almond flavoring in small amounts experimentally determined to produce a desired molded product flavor). To reduce bulk density and give the molded product a less "gummy" mouth feel, the mixture should include 1.25% citrus fiber and 2.45% oat fiber. Manugel-C, a solidifying agent available from Kelco Division of Merck & Co., Inc. (or an equivalent solidifying agent) is preferably included in an amount 0.4% by weight. A mold releasing agent (lubricant), such as Alpha-dim 90 (available from American Industries) or BFP-65K (also available from American Industries), is preferably also included in an amount of about 1% by weight to reduce adhesion between the molded pieces and the mold cavities.

The mold cavities are desirably shaped so that the molded pieces of prune paste have shape simulating pitted prunes (like piece 62 shown in Fig. 2), or berries (like piece 162 shown in Fig. 11).

Various modifications and alterations in the described method and apparatus of the invention will be apparent to those skilled in the art without departing from the scope and spirit of this invention. Although the invention has been described in connection with specific preferred embodiments, it should be understood that the invention as claimed should not be unduly limited to such specific embodiments.

WHAT IS CLAIMED IS:

1. A molding apparatus, including:

a frame;

a first wheel rotatably mounted to the frame, having an outer surface defining a first set of mold cavities;

a second wheel rotatably mounted to the frame, wherein the second wheel has an outer surface defining a second set of mold cavities, and wherein the outer surface of the second wheel faces the outer surface of the first wheel at a loading station; and

means for rotating the first wheel and counter-rotating the second wheel so that each of the mold cavities in the first set rotates into alignment with one of the mold cavities in the second set at the loading station, and so that each pair of aligned mold cavities travels along a path from the loading station to a release station, wherein the aligned mold cavities separate at said release station.

2. The apparatus of claim 1, also including:

food depositing means for depositing an input food between the first wheel and the second wheel at the loading station.

3. The apparatus of claim 2, wherein the food depositing means comprises:

a hopper for storing the input food;

means for heating the hopper to maintain the input food at a temperature sufficiently high to prevent the input food from setting up irreversibly; and

an extrusion nozzle for receiving input food from the hopper and extruding a sheet of the input

food between the first wheel and the second wheel at the loading station.

4. The apparatus of claim 1, also including:

wheel cooling means for cooling the first wheel and the second wheel as they counter-rotate to maintain the mold cavities at a temperature in a range from about -10°F to about 32°F.

5. The apparatus of claim 4, wherein a first channel extends through the first wheel and a second channel extends through the second wheel, and wherein the wheel cooling means includes:

means for causing chilled coolant fluid to flow through the first channel; and

means for causing chilled coolant fluid to flow through the second channel.

6. The apparatus of claim 5, also including:

a first shaft fixedly attached to the first wheel;

a means for rotatably mounting the first shaft to the frame;

a second shaft fixedly attached to the second wheel;

a means for rotatably mounting the second shaft to the frame;

a first fluid line, a portion of which extends through the first shaft, having an outlet end connected to an inlet of the first channel, for supplying a first portion of the chilled coolant fluid to the first channel; and

a second fluid line, a portion of which extends through the second shaft, having an outlet end connected to an inlet of the second channel, for

supplying a second portion of the chilled coolant fluid to the second channel.

7. The apparatus of claim 6, also including:

a coolant fluid tank; and

a return fluid line having inlet ends connected to outlets of first channel and the second channel, and having an outlet end connected to the coolant fluid tank, to enable the coolant fluid to flow from the first channel and the second channel back to the coolant fluid tank,

wherein the first fluid line and the second fluid line have inlet ends connected to the coolant fluid tank, to enable the chilled coolant fluid to flow into the first fluid line and the second fluid line from the coolant fluid tank.

8. The apparatus of claim 4, also including:

an enclosure surrounding the first wheel and the second wheel; and

carbon dioxide supply means for maintaining dry carbon dioxide gas at pressure greater than atmospheric pressure within the enclosure, to displace ambient air and water vapor thereby preventing the ambient air and water vapor from reaching the mold cavities.

9. The apparatus of claim 8, wherein the carbon dioxide supply means includes a set of air knives which direct carbon dioxide gas toward at least one of the first wheel and the second wheel.

10. The apparatus of claim 1, also including:

first product ejection means mounted at an ejection station adjacent to the outer surface of the first wheel for purging the mold cavities in the

first set of their contents as they translate past the ejection station.

11. The apparatus of claim 10, wherein the first product ejection means includes a set of air knives.

12. The apparatus of claim 11, also including:

means for supplying carbon dioxide gas to the air knives at sufficient pressure so that each air knife in the set of air knives directs a stream of said carbon dioxide gas onto the first wheel.

13. The apparatus of claim 10, also including:

second product ejection means mounted at a second ejection station adjacent the outer surface of the second wheel for purging the mold cavities in the second set of their contents as they translate past the second ejection station.

14. The apparatus of claim 1, also including:

at least one wire mounted alongside the first wheel and the second wheel, for cutting off excess food from edges of the first wheel as said first wheel rotates, and for cutting off excess food from edges of the second wheel as said second wheel counter-rotates.

15. The apparatus of claim 1, also including:

a set of cheek plates mounted near the loading station in a position for preventing the input food from escaping from the loading station except by being compressed between a pair of the aligned mold cavities.

16. The apparatus of claim 1, wherein the mold cavities are shaped to form an input food into molded pieces having pitted prune shape.

17. The apparatus of claim 1, wherein the mold cavities are shaped to form an input food into molded pieces having berry shape.

18. A method for molding food, including the steps of:

(a) extruding the food into a sheet; and

(b) molding portions of the sheet into pieces having desired shape by pressing the sheet between counter-rotating wheels, wherein the wheels have outer surfaces which define mold cavities.

19. The method of claim 18, wherein the food is a fruit paste, wherein step (b) includes the step of:

chilling the wheels to cause portions of the fruit paste to set up into said pieces as the portions are carried between aligned pairs of the mold cavities of the counter-rotating wheels from a loading station to a release station.

20. A molded food piece produced by performing the method of claim 19.

21. The method of claim 19, wherein the wheels are chilled sufficiently to maintain the mold cavities at a temperature in the range from about -10°F to about 32°F.

22. The method of claim 19, wherein the wheels are chilled sufficiently to maintain the mold cavities at a temperature substantially equal to 0°F.

23. The method of claim 19, also including the step of:

(c) heating the fruit paste to prevent said fruit paste from irreversibly setting up before performance of steps (a) and (b).

24. The method of claim 18, wherein step (b) includes the step of:

heating the wheels to cause portions of the food to set up into said pieces as the portions are carried between aligned pairs of the mold cavities of the counter-rotating wheels from a loading station to a release station.

25. The method of claim 18, wherein the food is a fruit paste, also including the step of:

(c) heating the fruit paste to a temperature in a range from about 180°F to about 212°F to prevent said fruit paste from irreversibly setting up before performance of steps (a) and (b).

26. The method of claim 18, wherein step (b) includes the step of carrying the pieces between aligned pairs of the mold cavities of the counter-rotating wheels from a loading station to a release station, and also including the step of:

(c) after step (b), positively purging the mold cavities of its contents at ejection stations.

27. The method of claim 26, wherein step (c) includes the step of:

blowing pressurized carbon dioxide gas at the wheels from air knives positioned at the ejection stations.

28. The method of claim 18, also including the step of:

misting empty ones of the mold cavities with a non-toxic mold release agent.

29. The method of claim 28, wherein the non-toxic mold release agent is glycerine.

30. A molded food piece produced by performing the method of claim 18.

31. The method of claim 18, wherein the food is a mixture comprising:

fruit paste, in an amount substantially equal to 60% by weight;

glycerine, in an amount substantially equal to 15-16% by weight;

citrus fiber, in an amount substantially equal to 1.25% by weight; and

oat fiber, in an amount substantially equal to 2.45% by weight.

32. The method of claim 31, wherein the mixture also comprises:

a solidifying agent, in an amount experimentally determined to produce a desired molded product hardness and texture.

33. The method of claim 31, wherein the mixture also comprises:

a solidifying agent, in an amount substantially equal to 0.4% by weight.

34. The method of claim 31, wherein the mixture also comprises:

sorbitol, in an amount experimentally determined to produce a desired molded product water activity and humectancy.

35. The method of claim 31, wherein, to adjust the sugar to acid ratio, the mixture also comprises:

fructose, in an amount substantially equal to 13% by weight;

sucrose, in an amount substantially equal to 3% by weight; and

citric acid, in an amount substantially equal to 0.12% by weight.

36. The method of claim 35, wherein the mixture also comprises:

tartaric acid, plum essence, and almond flavoring in amounts experimentally determined to produce a desired molded product flavor.

37. The method of claim 31, wherein the mixture also comprises:

a mold releasing agent, in an amount experimentally determined to reduce adhesion between the pieces and the mold cavities at following step (b) to a desired level.

38. The method of claim 31, wherein the mixture also comprises:

a mold releasing agent, in an amount substantially equal to about 1% by weight.

39. The method of claim 31, wherein the fruit paste is prune paste.

40. The method of claim 31, wherein the fruit paste has a water content substantially equal to 25%.

41. A molded food piece produced by performing the method of claim 31.

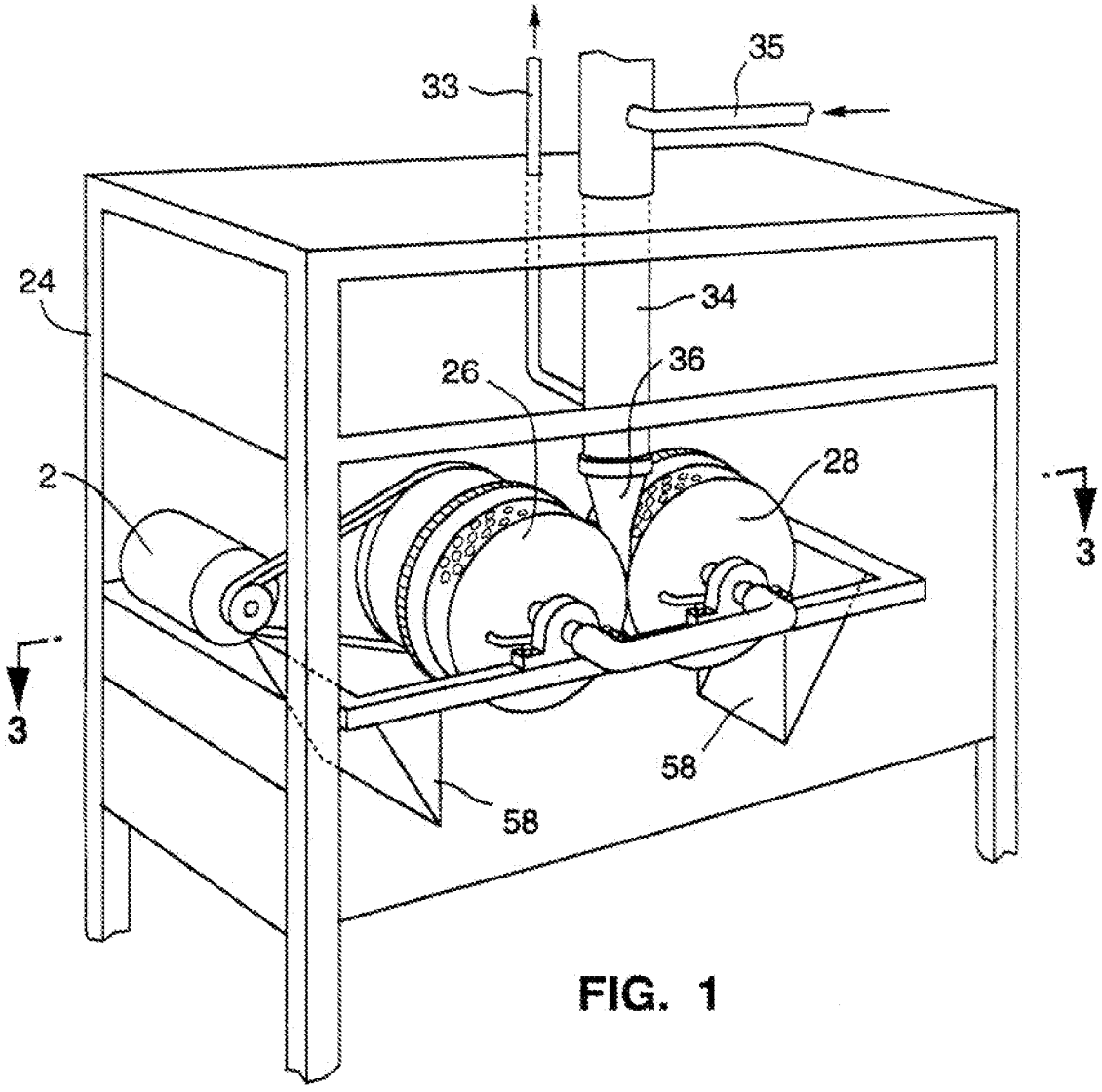


FIG. 1

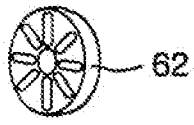


FIG. 2

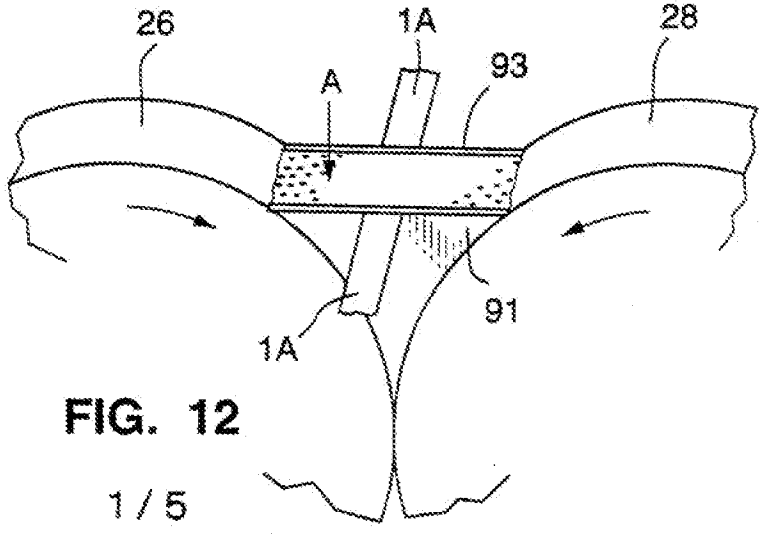
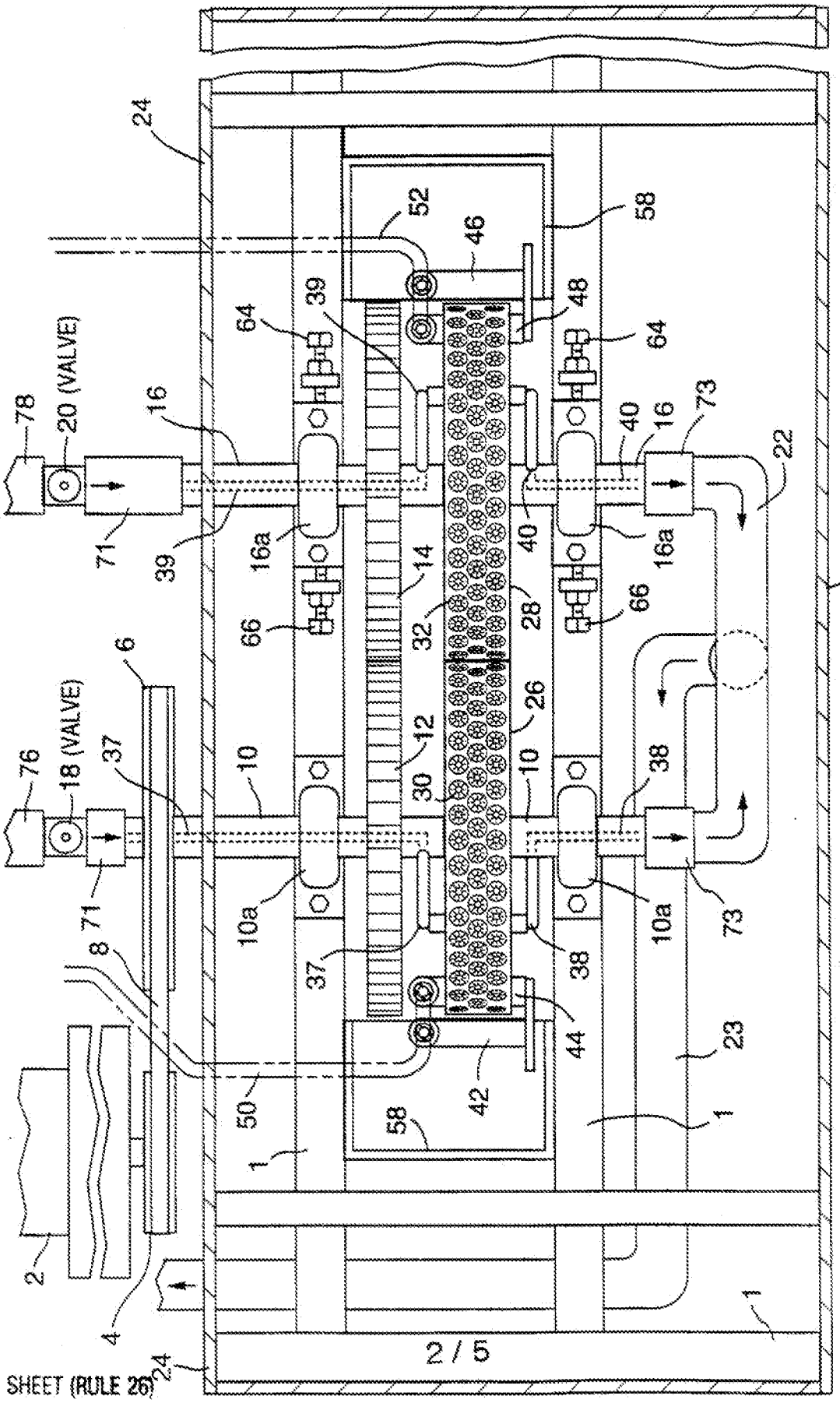


FIG. 12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18 (VALVE)
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FIG. 3

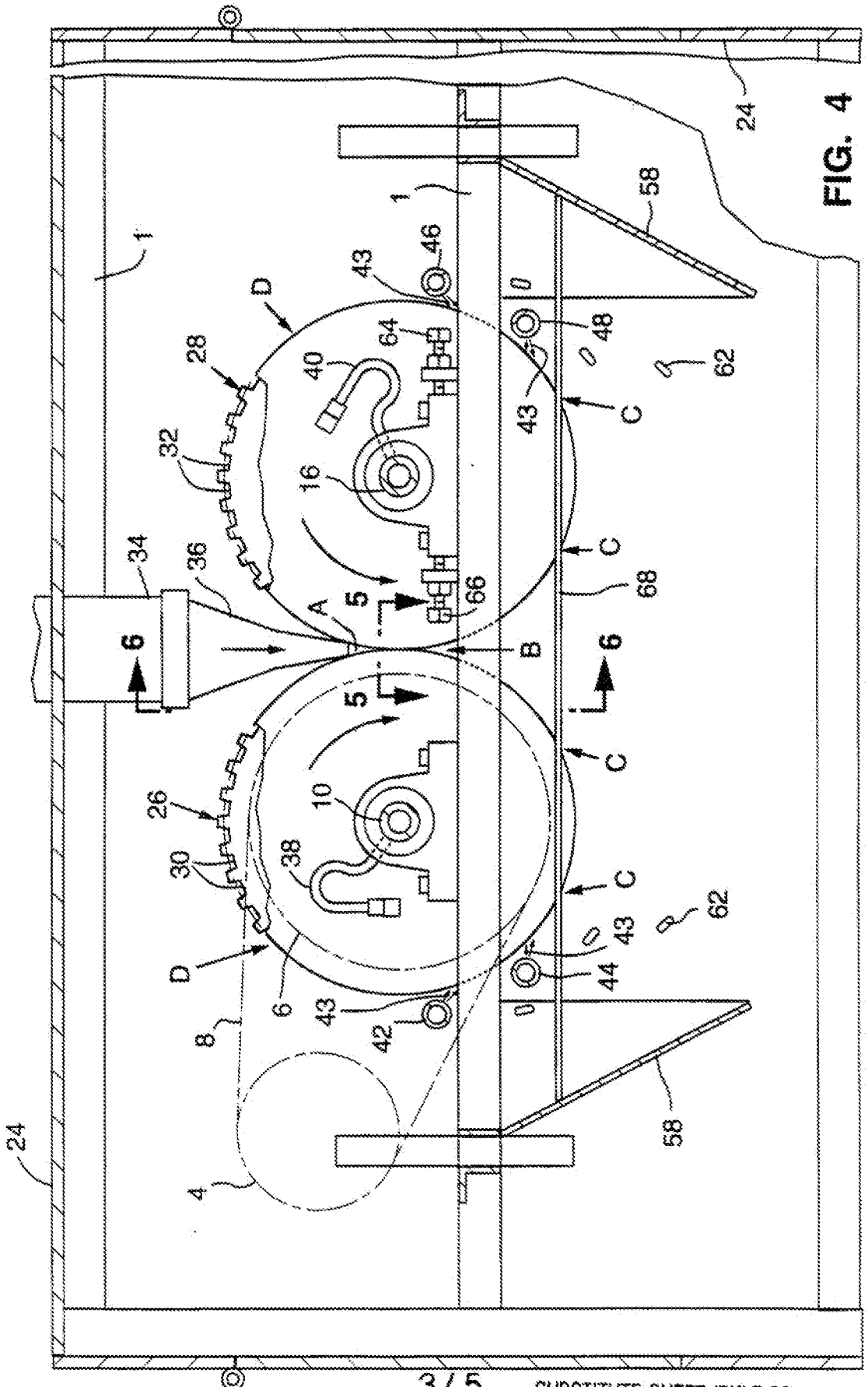
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FIG. 4

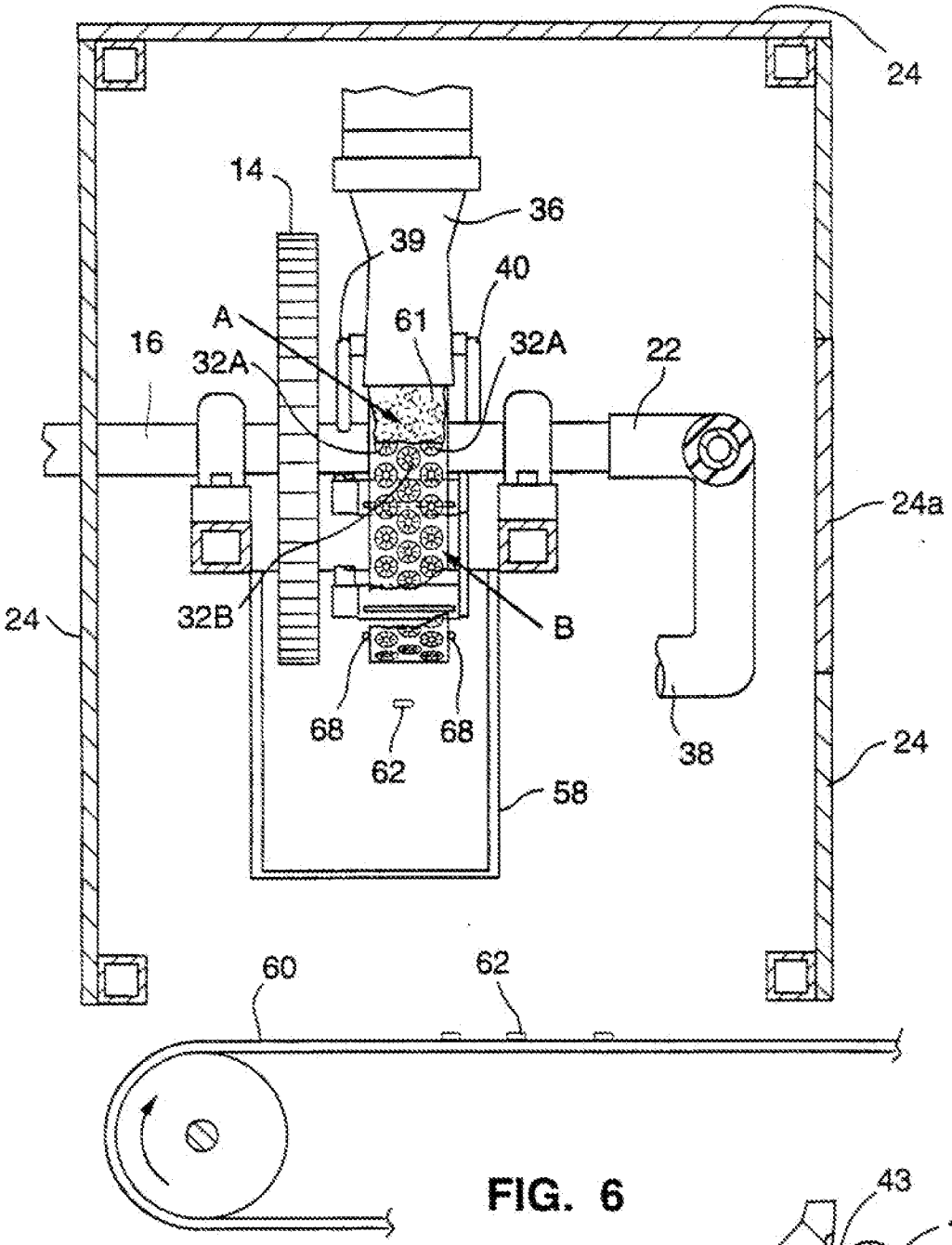

FIG. 6

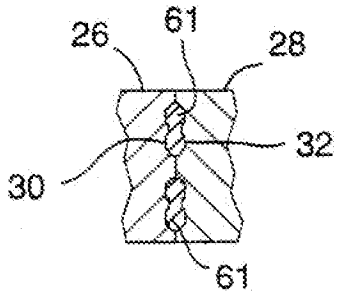

FIG. 5

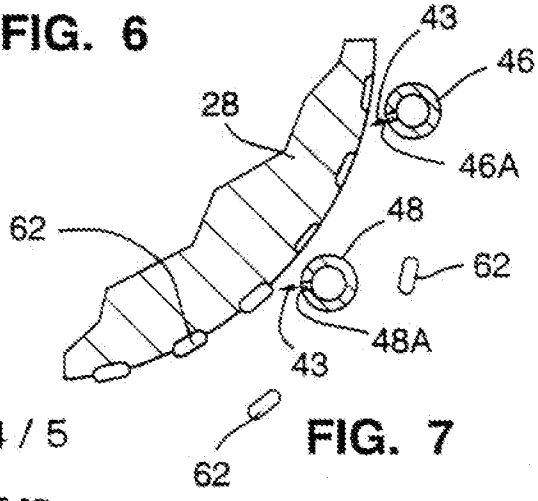

FIG. 7

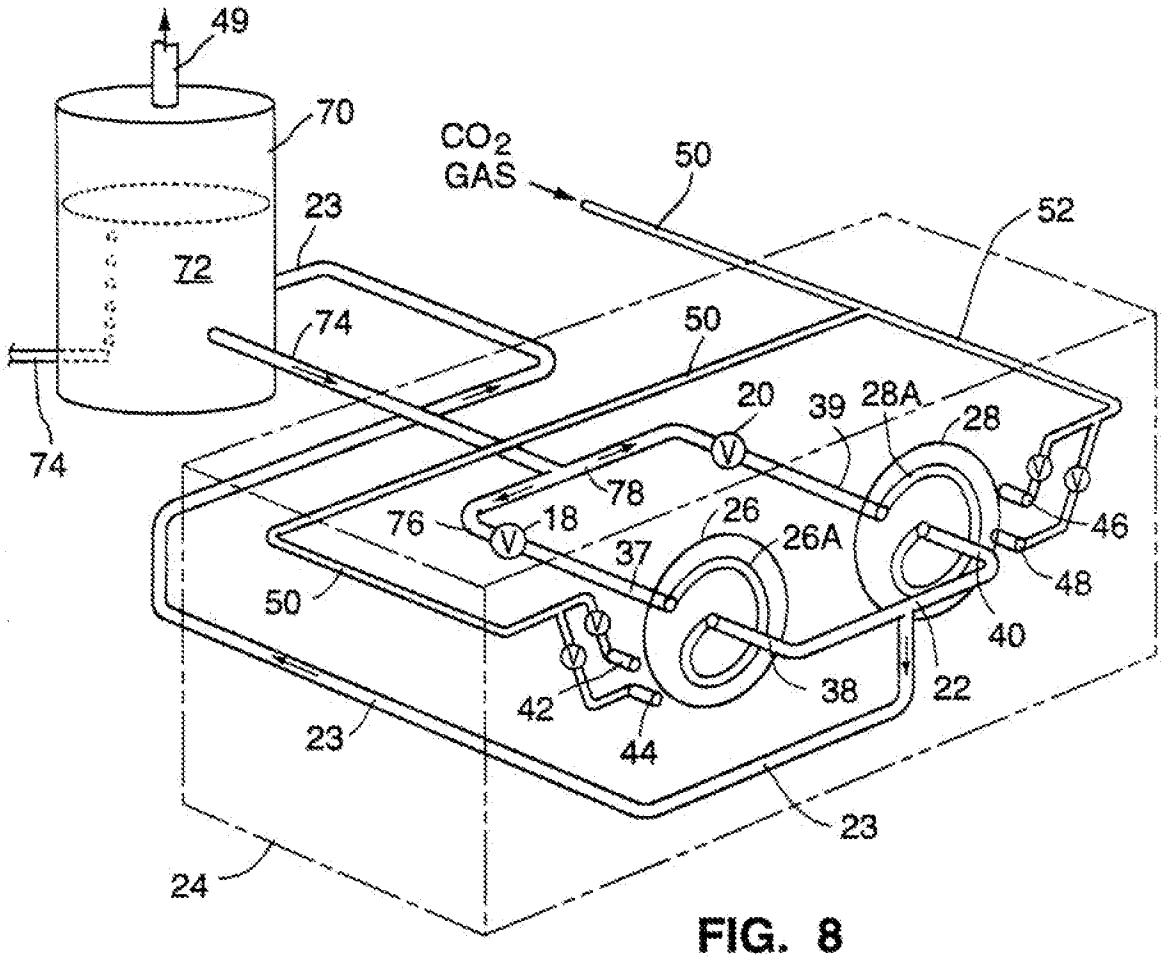

FIG. 8

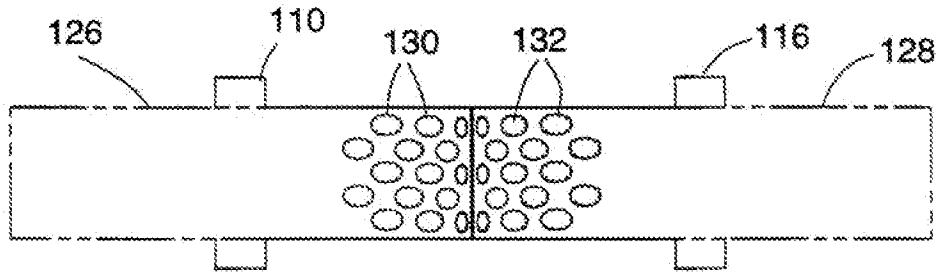

FIG. 9

FIG. 11

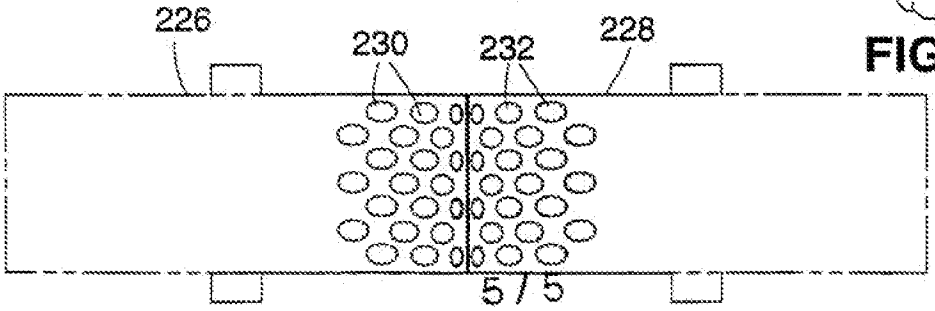

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/01999

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :A23P 1/00; B28B 13/00; B30B 3/00

US CL. :426/512, 615; 100/155, 907; 425/237, 446

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 425/294; 426/285

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US, A, 4,389,178 (KOMAREK) 21 June 1983, see the entire document.	1, 2 --- 3-17
X -- Y	US, A, 4,017,241 (PAPINCHAK ET AL) 12 April 1977, see the entire document.	1, 2 --- 3-17
X -- Y	US, A, 3,932,169 (ANTHONY, JR.) 13 January 1976, see the entire document.	1, 2 --- 3-17
X -- Y	US, A, 2,208,905 (KREMMLING ET AL) 23 July 1940, see the entire document.	1, 2 --- 3-17
Y,P	US, A, 5,199,269 (ANDERSON) 06 April 1993, see the	4-9

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 APRIL 1994	25 MAY 1994

Name and mailing address of the ISA/US	Authorized officer
Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	GEORGE C. YEUNG
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Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/01999

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 2,484,670 (BARKER) 11 October 1949, see the entire document.	18-41
Y,P	US, A, 5,198,257 (HECK ET AL) 30 March 1993, see the entire document.	18-41
Y	US, A, 5,084,296 (LUGAY ET AL) 28 January 1992, see the entire document.	18-41